

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

14

Claims

We claim the following:

- 1) (Canceled)
- 2) (Currently Amended) ~~The method of claim 1~~ A method of using a compound of the Formula
5 1 in a process,

(cation)(R'SO₄)

Formula 1

comprising the step of: employing the compound as a solvent, solvent additive, or
extraction solvent; or employing the compound as a heat carrier, or heat carrier additive,
10 wherein:

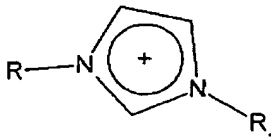
R' is selected from the group consisting of a linear or branched, saturated or unsaturated,
aliphatic or alicyclic, functionalized or non-functionalized alkyl radical with 3-36 carbon atoms,
wherein R' is optionally functionalized with one or more X groups; X is selected from the group
consisting of an -OH, -OR'', -COOH, -COOR'', -NH₂, -SO₄, -F, -Cl, -Br, -I or -CN; and R'' is
15 selected from the group consisting of a branched or linear hydrocarbon chain with 1 - 12 carbon
atoms;

the compound has a melting point of less than 100° C; and

wherein the cation is a nitrogen-containing cation selected from the group consisting of a
quaternary ammonium cation, an imidazolium cation, a pyridinium cation, a pyrazolium cation, a
20 phosphonium and a triazolium cation.

- 3) (Currently Amended) The method of claim 12, wherein the cation is selected from the group consisting of:

- a) quaternary ammonium cation with the general formula (NR₁R₂R₃R)⁺;
- b) phosphonium cation with the general formula (PR₁R₂R₃R)⁺;
- 25 c) imidazolium cation with the general formula



in which the imidazole core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-aryl-C₁-C₆ alkyl group;

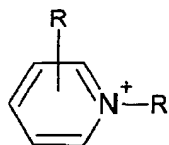
Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

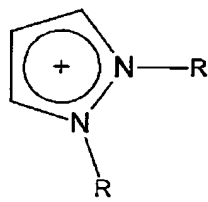
15

d) pyridinium cation with the general formula



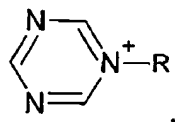
in which the pyridine core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-
5 aryl-C₁-C₆ alkyl group;

e) pyrazolium cation with the general formula



in which the pyrazole core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-
10 aryl-C₁-C₆ alkyl group; and

f) triazolium cation with the general formula



in which the triazole core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-
15 aryl-C₁-C₆ alkyl group; wherein

g) the radicals R¹, R², R³ are selected independently at each occurrence from the group consisting of:

i) hydrogen;

ii) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1
20 to 20 carbon atoms;

iii) heteroaryl groups, heteroaryl-C₁-C₆ alkyl groups with 3 to 8 carbon atoms in the heteroaryl radical and at least one heteroatom selected from N, O and S which is optionally substituted with at least one group selected from C₁-C₆ alkyl groups and/or

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

16

halogen atoms;

iv) aryl, aryl-C₁-C₆ alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C₁-C₆ alkyl group and/or a halogen atom; and

h) the radical R is selected from the group consisting of:

i) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;

ii) heteroaryl-C₁-C₆ alkyl groups with 3 to 8 carbon atoms in the aryl radical and at least one heteroatom selected from N, O and S, which is optionally substituted with at least one C₁-C₆ alkyl group and/or halogen atom; and

iii) aryl-C₁-C₆ alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C₁-C₆ alkyl group and/or halogen atom.

4) (Currently Amended) The method of claim 42, wherein the anion has an empirical formula selected from the group consisting of C₄H₉SO₄, C₈H₁₇SO₄ or C₁₂H₂₅SO₄.

5) (Currently Amended) The method of claim 42, wherein the compound of the Formula 1 has a melting point of less than 75° C.

6) (Currently Amended) The method of claim 42, wherein the compound of the Formula 1 has a melting point of less than 50° C.

7) (Currently Amended) The method of claim 42, wherein (R'SO₄) is an alkyl sulfate ester, wherein the alkyl moiety is selected from the group consisting of butyl, octyl, 2-ethylhexyl, and dodecyl; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

8) (Previously Amended) The method of claim 7, wherein the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and trihexyltetradecylphosphonium.

9) (Currently Amended) The method of claim 42, wherein the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

17

decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and trihexyltetradecylphosphonium; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

10) (Currently Amended) The method of claim 42, wherein the compound of the Formula 1 is used in a reaction catalyzed by a transition metal; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

11) (Previously Amended) The method of claim 10, wherein the compound of the Formula 1 is used in a hydroformylation reaction, oligomerization reaction, esterification reaction, isomerization reaction or amide bond-forming reaction.

12) (Currently Amended) The method of claim 42, wherein the compound of the Formula 1 is used in a reaction catalyzed by an enzyme or biocatalyst; and the method comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst.

13) (Previously Amended) The method of claim 12, wherein the compound of the Formula 1 is used in an oligomerization reaction, C-C bond-forming reaction, esterification reaction, isomerization reaction, or amide bond-forming reaction.

14) (Currently Amended) The method of claim 42, wherein the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

15) (Currently Amended) The method of claim 42, wherein the compound of the Formula 1 has a melting point of less than 25° C.

16) (Currently Amended) The method of claim 42, wherein the compound is selected from the group consisting of:

- a) 1-ethyl-3-methylimidazolium butyl sulfate;
- b) 1-ethyl-3-methylimidazolium octyl sulfate;
- c) 1-ethyl-3-methylimidazolium 2-ethylhexyl sulfate;

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

18

- d) 1-ethyl-3-methylimidazolium dodecyl sulfate;
- e) 1-butyl-3-methylimidazolium butyl sulfate;
- f) 1-butyl-3-methylimidazolium octyl sulfate;
- g) 1-butyl-3-methylimidazolium 2-ethylhexyl sulfate;
- 5 h) 1-butyl-3-methylimidazolium dodecyl sulfate;
- i) 1-hexyl-3-methylimidazolium butyl sulfate;
- j) 1-hexyl-3-methylimidazolium octyl sulfate;
- k) 1-hexyl-3-methylimidazolium 2-ethylhexyl sulfate;
- l) 1-hexyl-3-methylimidazolium dodecyl sulfate;
- 10 m) 1-octyl-3-methylimidazolium butyl sulfate;
- n) 1-octyl-3-methylimidazolium octyl sulfate;
- o) 1-octyl-3-methylimidazolium 2-ethylhexyl sulfate;
- p) 1-octyl-3-methylimidazolium dodecyl sulfate;
- q) 1-decyl-3-methylimidazolium butyl sulfate;
- 15 r) 1-decyl-3-methylimidazolium octyl sulfate;
- s) 1-decyl-3-methylimidazolium 2-ethylhexyl sulfate;
- t) 1-decyl-3-methylimidazolium dodecyl sulfate;
- u) 1-dodecyl-3-methylimidazolium butyl sulfate;
- v) 1-dodecyl-3-methylimidazolium octyl sulfate;
- 20 w) 1-dodecyl-3-methylimidazolium 2-ethylhexyl sulfate;
- x) 1-dodecyl-3-methylimidazolium dodecyl sulfate;
- y) 1-butyl-pyridinium butyl sulfate;
- z) 1-butyl-pyridinium octyl sulfate;
- aa) 1-butyl-pyridinium 2-ethylhexyl sulfate;
- 25 bb) 1-butyl-pyridinium dodecyl sulfate;
- cc) trimethyldecylammonium butyl sulfate;
- dd) trimethyldecylammonium 2-ethylhexyl sulfate;
- ee) trioctylmethylammonium butyl sulfate;
- ff) trioctylmethylammonium octyl sulfate;
- 30 gg) trioctylmethylammonium 2-ethylhexyl sulfate;
- hh) trioctylmethylammonium dodecyl sulfate;

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

19

- ii) trimethyldecylammonium butyl sulfate;
- jj) trimethyldecylammonium octyl sulfate;
- kk) trihexyltetradecylphosphonium butyl sulfate;
- ll) trihexyltetradecylphosphonium octyl sulfate;
- 5 mm) trihexyltetradecylphosphonium 2-ethylhexyl sulfate;
- nn) trihexyltetradecylphosphonium dodecyl sulfate; and the method comprises the step of:
 - employing the compound as a solvent, solvent additive, or extraction solvent; or
 - employing the compound as a heat carrier, or heat carrier additive; or employing the
 - compound as a phase transfer catalyst.

10 17) (Previously Amended) A method of using a compound of the Formula 1 in a process

(cation)(R'SO₄)

Formula 1

comprising the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive,

15 wherein:

R' is selected from the group consisting of a linear or branched, saturated or unsaturated, aliphatic or alicyclic, functionalized or non-functionalized alkyl radical with 3-36 carbon atoms, wherein R' is optionally functionalized with one or more X groups; X is selected from the group consisting of an -OH, -OR'', -COOH, -COOR'', -NH₂, -SO₄, -F, -Cl, -Br, -I or -CN; and R'' is

20 selected from the group consisting of a branched or linear hydrocarbon chain with 1 - 12 carbon atoms;

the compound has a melting point of less than 100° C;

the cation is a nitrogen-containing cation selected from the group consisting of a quaternary ammonium cation, an imidazolium cation, a pyridinium cation, a pyrazolium cation, a

25 phosphonium and a triazolium cation;

the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

18) (Previously Amended) The method of claim 17, wherein (R'SO₄) has an empirical formula selected from the group consisting of C₄H₉SO₄, C₈H₁₇SO₄ or C₁₂H₂₅SO₄, and; the method

30 comprises the step of: employing the compound as a solvent, solvent additive, or extraction solvent; or employing the compound as a heat carrier, or heat carrier additive; or employing

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

20

the compound as a phase transfer catalyst.

19) (Previously Amended) A method of using a compound of the Formula 1 in a process

(cation)(R'SO₄)

Formula 1

5 comprising the step of: employing the compound as a solvent, solvent additive, or extraction solvent; employing the compound as a heat carrier, or heat carrier additive; or employing the compound as a phase transfer catalyst, wherein:

a) (R'SO₄) is an alkyl sulfate ester, wherein the alkyl moiety is selected from the group consisting of butyl, octyl, 2-ethylhexyl, and dodecyl;

10 b) the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and
15 trihexyltetradecylphosphonium;

c) the compound has a melting point of less than 100° C; and

d) the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

20 20) (Previously Amended) The method of claim 19, wherein the process is a reaction catalyzed by a transition metal, and the reaction is a hydroformylation reaction, oligomerization reaction, esterification reaction, isomerization reaction or amide bond-forming reaction.

21) (Previously Amended) The method of claim 19, wherein the process is a reaction catalyzed by an enzyme or biocatalyst, and the reaction is an oligomerization reaction, C-C bond-forming reaction, esterification reaction, isomerization reaction, or amide bond-forming
25 reaction.

22) (Previously added) The method of claim 18, wherein the cation is selected from the group consisting of:

a) quaternary ammonium cation with the general formula (NR₁R₂R₃R)⁺;

b) phosphonium cation with the general formula (PR₁R₂R₃R)⁺;

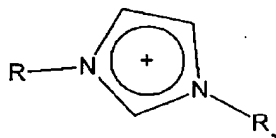
30 c) imidazolium cation with the general formula

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

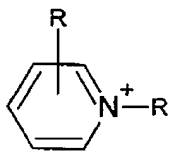
Docket No. VSKW-1

21



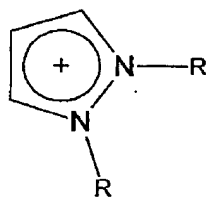
in which the imidazole core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-aryl-C₁-C₆ alkyl group;

- 5 d) pyridinium cation with the general formula



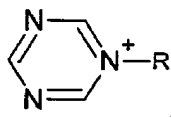
in which the pyridine core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-aryl-C₁-C₆ alkyl group;

- 10 e) pyrazolium cation with the general formula



in which the pyrazole core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-aryl-C₁-C₆ alkyl group; and

- 15 f) triazolium cation with the general formula



in which the triazole core is optionally substituted with at least one group selected from C₁-C₆ alkyl group, C₁-C₆ alkoxy group, C₁-C₆ aminoalkyl group, C₅-C₁₂ aryl group or C₅-C₁₂-aryl-C₁-C₆ alkyl group; wherein

- 20 g) the radicals R¹, R², R³ are selected independently at each occurrence from the group

Applicant: Wasserscheid et al.
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

22

consisting of:

i) hydrogen;

ii) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;

5 iii) heteroaryl groups, heteroaryl-C₁-C₆ alkyl groups with 3 to 8 carbon atoms in the heteroaryl radical and at least one heteroatom selected from N, O and S which is optionally substituted with at least one group selected from C₁-C₆ alkyl groups and/or halogen atoms;

10 iv) aryl, aryl-C₁-C₆ alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C₁-C₆ alkyl group and/or a halogen atom; and

h) the radical R is selected from the group consisting of:

i) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;

15 ii) heteroaryl-C₁-C₆ alkyl groups with 3 to 8 carbon atoms in the aryl radical and at least one heteroatom selected from N, O and S, which is optionally substituted with at least one C₁-C₆ alkyl group and/or halogen atom; and

iii) aryl-C₁-C₆ alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C₁-C₆ alkyl group and/or halogen atom.

20